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GEOMETRY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

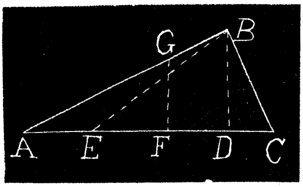
SOLUTIONS OF PROBLEMS.

50. Proposed by B. F. FINKEL, A. M., Professor of Mathematics and Physics, Drury College, Springfield, Missouri.

Divide a triangle into the ratio of m to n by a line perpendicular to the base.

Solution by J. C. GREGG, Superintendent of Schools, Brazil, Indiana; E. W. MORRELL, Professor of Mathematics, Montpelier Seminary, Montpelier, Vermont; and the PROPOSER.

Let ABC be the triangle. Draw the altitude BD. Divide the base AC at E so that $AE : EC = m : n$. Draw the line BE.



Then $\triangle ABE : \triangle EBC = AE : EC = m : n$.....(1).

Take AF a mean proportional between AE and AD, then draw GF parallel to BD.

Then $\triangle AFG : \triangle ADB = AF^2 : AD^2$.

But $AF^2 = AE \times AD$.

$\therefore \triangle AFG : \triangle ADB = AE \times AD : AD^2 = AE : AD = \triangle ABE : \triangle ADB$.

$\therefore \triangle AFG = \triangle ABE$ and $\triangle EBC = FGBC$.

Hence, using in (1), we have $\triangle AFG : FGBC = m : n$. Q. E. D.

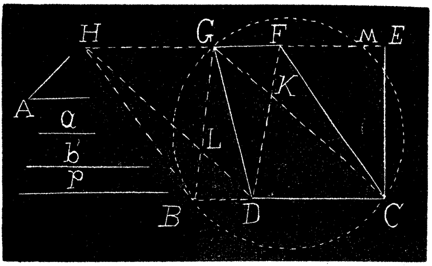
Also solved in various ways by *G. B. M. ZERR, B. F. YANNEY, J. SCHEFFER, A. H. BELL, F. R. HONEY, O. W. ANTHONY, H. J. GAERTNER, G. I. HOPKINS, J. M. COLAW, J. O. MAHONEY.*

51. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science in Texarkana College, Texarkana, Arkansas-Texas.

Construct a tropezoid, given the bases, the altitude, and the angle formed by the intersection of the diagonals.

Solution by J. OWEN MAHONEY, B. E., Graduate Fellow and Assistant in Mathematics, Vanderbilt University, Nashville, Tennessee; FREDERICK R. HONEY, A. B., New Haven, Connecticut; J. SCHEFFER, Hagerstown, Maryland; B. F. SINE, Principal of High School, Rock Enon Springs, Virginia; and PROPOSER.

Let a and b be the bases, p the perpendiculars, and A the angle between the diagonals.



Take $BC = a + b$ and describe upon BC a segment to contain an angle = to A. The problem is possible when p is less than the greater segment of the diameter perpendicular to BC. Take $CE = p$ and perpendicular to BC. Draw EH parallel to BC cutting the circle in M and G. Draw BG and GC. Also draw DF parallel to BG and DH parallel to GC.

Then is *DCFG* or *BDGH* the required trapezoid. For $BD=GF=b$, $DC=HG=a$, $\angle DKC=\angle BLD=\angle BGC=A$, and $CE=p$. By treating the point m as we did G we get two other trapezoids answering all conditions.

This problem was solved in a similar manner by *COOPER D. SCHMITT*, *A. H. BELL*, *J. SCHEFFER*, *B. F. SINE*, *J. M. COLAW*, *P. S. BERG*, *O. W. ANTHONY*, *E. W. MORRELL*, *J. C. GREGG*, and *H. J. GAERTNER*.

PROBLEMS.

56. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

The locus of the centers of the isogonal transformations of all the diameters of the circumcircle of any triangle is the nine-points circle. *Brocard.*

57. Proposed by J. OWEN MAHONEY, B. E., Graduate Fellow and Assistant in Mathematics, Vanderbilt University, Nashville, Tennessee.

Show that pairs of points, on a straight line may be so related harmonically that a pair of real points will be harmonic with regard to a pair of imaginary points, and by this means prove that there are an indefinite number of conjugate pairs of imaginary points on a real line.

* * *

CALCULUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

45. Proposed by GEORGE LILLEY, Ph. D., LL. D., Principal of Park School, 394 Hall Street, Portland, Oregon.

A fly starts from a point in the circumference of a table, 3 feet in diameter, and travels uniformly along the diameter to a point in the circumference of the table directly opposite the starting point. The table moves uniformly to the right about a center axis in such manner that it makes one complete revolution while the fly passes over its diameter. Find the absolute path described by the fly and the ratio of rates of movement of the table and the fly.

I. Solution by the PROPOSER.

The curve described by the fly is the spiral of Archimedes. Its equation is $r=a\theta$. $S=\int_0^\pi\left(\sqrt{r^2+\left(\frac{dr}{d\theta}\right)^2}\right)d\theta, =\frac{a\pi\sqrt{1+\pi^2}}{2}+\frac{a}{2}\log(\pi+\sqrt{1+\pi^2})$.

Hence, $2S$, or the absolute path described by the fly, is 63.994+ inches. If we take the Naperian logarithm of $(\pi+\sqrt{1+\pi^2})$ the result is 69.6+ inches.